

EFFECTS OF A SPECIAL TECHNIQUE FOR RIGHT-OF-WAY MAINTENANCE ON DEER HABITAT

by W. C. Bramble, W. R. Byrnes, and R. J. Hutnik¹

Abstract. White-tailed deer (*Odocoileus virginiana*) habitat and use were evaluated on an electric transmission right-of-way (ROW) before and after 5 different herbicide treatments and handcutting were applied using a special technique. Evaluations also were made in the adjoining forest. The technique used for all treatments provided for division of the ROW into a central wire zone and two border zones. Selective treatment of only tall-growing trees was carried out on the border zones; as contrasted with complete treatment of all trees and tall shrubs in the wire zone. In addition, a special broadcast application was given to the wire zone in the case of the herbicide pellet treatment to produce a herb-grass plant cover. Although appreciable changes occurred in specific deer habitat factors, decreases in certain factors were offset by increases in other factors. As a consequence, total habitat values remained high. Deer presence increased on all ROW treatment areas from 1982 to 1984. Deer browsed both woody and herbaceous vegetation comparably on the ROW and in the forest. The utilization factor, percent cover x percent browsed, was higher for woody vegetation in the forest and for herbaceous vegetation on the ROW.

Key words: Right-of-way; Deer; Herbicides; Herbicide maintenance.

The effect of a special maintenance technique on white-tailed deer habitat was studied on a 58 m-wide electric transmission right-of-way (ROW) in an oak-hickory forest in central Pennsylvania. The major objective of the study was to compare habitat values considered desirable for deer before and after various herbicide treatments. Relative deer presence in the right-of-way and adjacent forest also was evaluated. White-tailed deer was used as a test species to compare treatment effects because deer are common in the study area, and are important as game mammals.

Literature Review

Although the general effects of herbicide ROW maintenance on white-tailed deer has been described by several investigators (Cavanagh et al., 1976; Carvell and Johnston, 1978; Bramble and Byrnes, 1982), none has studied deer habitat values and use before and after herbicide treat-

ments. The response of preferred deer food plants to selected basal sprays of 2,4-D and picloram was studied in New Hampshire and New Jersey (Carvell and Johnston, 1978). After rating dominant plants as potential food for white-tailed deer, they found the ROW to be of high value and essentially similar to old fields in food production. Another study reported that white-tailed deer use was higher on a ROW that had been selectively cut than on a clearcut ROW, or a forested area (Cavanagh et al., 1976). A study in Pennsylvania of the effects of ROW spraying 2,4-D, 2,4,5-T, and AMS reported that long-term selective maintenance with herbicides produced excellent deer food and cover, and that deer used these areas intensively (Bramble and Byrnes, 1982).

Methods

ROW treatments, 1982. Treatments were applied to ROW areas (treatment units) of 1.1 ha that were replicated 5 times along a 4.8 km segment of the ROW. Before treatment in July-August, 1982, the ROW was divided into a 23 m-wide wire zone and 2 border zones approximately 18 m-wide (Figure 1). These zones were given special treatments as described in the following summary:

1. *Handcutting (control standard)* removed all trees and tall shrubs in the wire zone with slash lopped and left as it fell. The two border zones were selectively cut to remove only tall-growing tree species which included red maple (*Acer rubrum*), black cherry (*Prunus serotina*), and several oaks (*Quercus* spp.).

2. *Summer basal spray* of Garlon 4 (triclopyr) in oil-water was applied at a rate of 5.7 L per M (thousand) plants to all trees and tall shrubs in the wire zone; witch-hazel (*Hamamelis virginiana*) and bear oak (*Quercus ilicifolia*) were left in the border zone where all trees were sprayed.

¹Professor Emeritus and Professors of Forestry, Purdue University, and The Pennsylvania State University, respectively, in cooperation with the Pennsylvania Game Commission, Union Carbide Agricultural Products, Inc., Asplundh Tree Expert Company, and the Pennsylvania Electric Company (GPU).

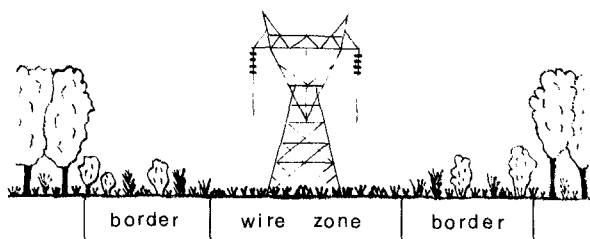


Figure 1. Diagram of an electric transmission ROW divided into a wire zone and 2 border zones. Low-growing tree species and tall shrubs were retained only in border zones.

3. *Selective stem-foliage spray of Weedone 2,4-DP (dichlorprop) plus Amdon 101 (picloram + 2,4D)* was applied at a rate of 5.7 L per M plants for each chemical to all trees and tall shrubs in the wire zone; witch-hazel and bear oak were left in the border zones where all trees were sprayed (Figure 2).

4. *Tordon 10 K pellets (picloram)* were broadcast in the wire zone at a rate of 4.3 kg per ha, and applied selectively to trees in the border zones except for a 7.6 m strip along each edge of the ROW which was given a selective basal spray of Garlon 4 in oil-water to avoid potential damage from herbicide pellets to trees in the adjoining forest.

5. *Selective frill and squirt application of Tordon RTU (picloram + 2,4-D)* was applied to trees only over the entire ROW at a rate of 2.7 L per M plants.

Habitat evaluation. Deer habitat evaluation was made on 2 ROW treatment units. A 10 m x 55 m transect which extended across the ROW and 10 m into the forest edge was randomly located within each unit and a similar adjoining transect was established in the forest. Deer habitat was evaluated by a similar method developed for ROW by Bramble and Byrnes (1979). This method involves 7 vegetation habitat factors that are considered important to white-tailed deer and may be affected by ROW maintenance. The 7 habitat factors were separated into 2 groups for evaluation: 4 direct factors that included food plant abundance, food plant diversity, low plant cover, and tall shrub cover; and, 3 indirect factors including external shrub borders, interspersions of cover types, and stage of plant succession. Each direct factor was rated at 5 levels from 2 to 10, and each

indirect factor was rated at 5 levels from 1 to 5 (Table 2). To obtain the habitat value, averages of the direct and indirect factors were added and then multiplied by $\frac{2}{3}$ to reduce the value to a 1-10 range and then were grouped into 3 classes as follows: 2-5 = low value; 5.1-6.9 = medium value; and 7-10 = high value.

Deer presence. Use of the ROW by deer was based on fecal group counts taken in July, 1982, before treatment, and again in July, 1983 and 1984. Two transects, each 0.9 m x 30.3 m, and extending across the ROW from edge to center on alternate sides, were placed at random in each of two treatment units for fecal group counts (Bramble and Byrne, 1972). Transects were cleared of fecal pellets after each count. As both summer and winter fecal groups were found to remain visible for more than 1 year on this ROW, and as the vegetative cover was closely scrutinized for fecal groups, the July counts were reasonably accurate and conservative. Deer days per ha were calculated from fecal group counts (Eberhart and Van Etten, 1956) by the formula:

$$\text{Deer days per ha} = \frac{\text{no. of fecal groups per ha}}{\text{no. fecal groups deposited by 1 deer in 1 day (averages 13)}}$$

Deer browsing. Browsing of woody and herbaceous vegetation on ROW treatment units in the forest was evaluated in 1984 by the classes listed below (Aldous, 1944):



Figure 2. Stem-foliage sprayed ROW with hayscented fern in the wire zone (W) and witch-hazel in the border zones (B).

Percent browsed	Value used
50% or more	70%
10 to 50%	30%
5 to 10%	5%
trace to 5%	2.5%

To take into account variations in the availability of browse, a utilization factor was calculated by multiplying the percent browsed by percent cover (Table 3). Cover percent was estimated by projecting the foliage of food plants onto the ground surface. The following cover classes were used:

Cover percent	Value used
Less than 5%	2.5
5-25%	15.0
25-50%	37.5
50-75%	62.5
75-100%	87.5

Results

Control of tree species. The control of trees capable of interference with electric transmission formed an important part of this study, because to be of practical value, a ROW treatment should have controlled trees before being evaluated for its impact upon nontarget plants that furnish wildlife food and cover.

The percent reduction in trees over 0.9 m in height on the ROW from 1982 to 1984 was: hand-cutting 23%; summer basal 71%; stem-foliage 73%; pellets 80%; and frill and squirt 43%. Height control of trees by all treatments was satisfactory. Relative costs of the 5 maintenance treatments were compared on the basis of a Cost-effectiveness Quotient (CEQ) (Table 1):

$$CEQ = \frac{\text{Cost/1000 stems (\$)}}{\text{Stem reduction (\%)}} \times 100$$

This quotient takes into account both cost of

Table 2. White-tailed deer habitat factor ratings and habitat values on ROW treatment areas in 1982 (pretreatment) and in 1983 and 1984 (post-treatment). Each value is an average of 4, 10m x 55m, transects on 2 treatment replications.

Habitat factors	ROW Treatments												Adjoining Forest					
	Handcutting			Summer basal			Stem-foliage			Pellet			Frill & Squirt			'82	'83	'84
	'82	'83	'84	'82	'83	'84	'82	'83	'84	'82	'83	'84	'82	'83	'84			
Direct factors rated 2-10																		
Food plant abundance	6.1	7.5	5.6	7.5	7.8	8.1	9.8	6.0	6.5*	9.0	6.5	5.9*	8.0	8.0	6.7	7.3	7.3	5.7
Food plant diversity	9.0	8.0	8.0	10.0	7.0	7.5	10.0	6.0	6.5*	10.0	6.0	8.0	10.0	10.0	7.0	7.8	6.6	7.5
Low plant cover	6.0	10.0	9.0*	10.0	10.0	9.0	7.0	10.0	10.0*	8.0	6.0	9.5	10.0	10.0	10.0	9.0	9.8	8.0
Tall shrub cover	9.0	6.0	7.5	5.0	6.0	4.5	7.0	6.8	4.5	6.0	4.0	5.0	8.0	8.0	5.5	4.0	5.2	5.7
Average	7.5	7.9	7.5	8.1	7.7	7.3	8.5	7.2	6.9	8.3	5.6	7.1	9.0	9.07.3	7.0	7.2	6.7	
Indirect factors rated 1-5																		
External shrub borders	4.0	3.5	3.0	4.0	4.0	4.0	4.0	3.5	3.3	3.0	3.5	2.8	4.7	3.5	4.0	—	—	—
Type interspersion	3.0	4.0	4.0	3.0	3.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0	3.0	3.0	4.0	2.0	2.2	2.1
Stage in succession	5.0	5.0	4.5	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	4.0	2.4	2.4	2.0
Average	4.0	4.2	3.8	4.0	4.0	4.0	4.0	4.5	4.1	3.7	4.5	3.9	4.2	3.8	4.0	2.2	2.3	2.1
Habitat value ¹	7.7	8.1	7.5	8.1	7.8	7.5	8.3	7.8	7.3	8.0	6.7	7.3	8.8	8.5	7.5	6.1	6.3	5.9
Habitat class ²	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	M	M	M

¹Habitat value = average of direct factors + average of indirect factors x 2/3.

²Habitat class: high (H) = values 7-10; medium (M) = value 5.1-6.9; low (L) = values 2-5.

*Difference between 1982 and 1984 is significant at the 5% level, t-test.

application in 1982 and effectiveness of a treatment in 1984 in reducing the number of tree stems present on the ROW. A low CEQ indicates a desirable cost-effectiveness (Table 1). For example, the application costs to treat 1000 stems by hand-cutting and summer basal were nearly equal, \$143 and \$142, respectively. However, when stem reduction was taken into account, the more effective summer basal showed a superior cost-effectiveness expressed by the quotient of 200 as compared with 622 for handcutting. Stem-foliage treatment cost-effectiveness quotient was only 123 owing to a combination of low application cost and excellent stem reduction.

Vegetation on the ROW. The pretreatment plant community on the ROW represented a shrub-herb-grass successional stage that developed after previous maintenance treatments (Bramble and Byrnes, 1982). In 1982, trees had again appeared on the ROW and a maintenance treatment was scheduled for that year.

Nearly all of the plant species on the ROW were capable of spreading by rhizomes or shallow roots which is typical of ROW vegetation and important to an understanding of the reaction of vegetation

to disturbance. The tall shrub layer (greater than 0.9 m) was dominated by blackberry (*Rubus allegheniensis*) with witch-hazel and bear oak also important tall shrubs. The low plant cover (less than 0.9 m) was composed of blueberry (*Vaccinium angustifolium* and *V. vacillans*), dewberry (*Rubus hispidus*), and various herbs and grasses. The cover values of these 2 layers of vegetation were 2 of the 4 direct factors used in the habitat evaluation (Table 2).

Important preferred food plants, used by deer (Liscinsky et al., 1973), found on the ROW were listed on the field form as follows:

Table 1. Cost-effectiveness quotient (CEQ),¹ based on application cost and stem reduction, for comparing ROW maintenance treatments.

Treatment	Application cost per 1000 stems \$	Reduction of stem density %	CEQ
Stem-foliage	90	73	123
Summer basal	142	71	200
Pellet	239	80	299
Frill & squirt	143	43	333
Handcutting	143	23	622

¹See text

Table 3. Deer browsing of woody and herbaceous vegetation and utilization factors in ROW wire and border zones of treatment areas and in the adjoining forest.

Treatment	Wire zone		N. border zone		S. border zone		ROW av.		Adjoining forest	
	Woody	Herb.	Woody	Herb.	Woody	Herb.	Woody	Herb.	Woody	Herb.
Percent browsed										
Handcutting	10.6	2.5	5.0	2.5	4.4	2.5	6.7	2.5	11.3	2.5
Summer basal	3.8	2.5	4.4	2.5	2.5	2.5	3.6	2.5	10.6	2.5
Stem-foliage	16.9	3.3	12.5	2.5	10.0	2.5	13.1	2.8	9.4	2.5
Pellet	32.5	4.4	3.1	3.8	3.3	2.5	13.0	3.6	7.5	5.0
Frill & squirt	6.3	4.1	10.6	3.1	4.4	3.1	7.1	3.1	10.0	1.9
Average	14.0	3.2	7.1	2.9	4.9	2.6	8.7	2.9	9.8	2.9
Utilization factor¹										
Handcutting	544	85	407	56	248	35	400	59	452	75
Summer basal	114	128	209	128	128	116	150	124	398	63
Stem-foliage	169	33	104	150	288	172	187	118	435	53
Pellet	62	226	83	261	196	44	114	177	385	169
Frill & squirt	323	159	358	194	105	252	262	202	475	59
Average	242	126	232	158	193	124	223	136	429	84

¹Utilization factor = % browsed x % cover.

Trees and shrubs	
<i>Fruit</i>	<i>Leaves and twigs</i>
Bear oak	Bear oak
Blackberry	Blackberry
Black cherry	Black cherry
Blueberry	Blueberry
Hawthorn	Hawthorn
Other oaks	Teaberry
	Red maple
	Sassafras
	Sweetfern
	Witch-hazel
	Other oaks
Herbaceous plants	
<i>Stems and leaves</i>	
Goldenrod	
Loosestrife	
Bracken	
Sedge	
Panic grass	
Fescue	
Sheep sorrel	
Wild sarsaparilla	

Effects of ROW treatment on deer habitat.

The greatest impact on vegetation was expected within 2 years after ROW treatment. At that time, vegetation should be dead around the base of sprayed trees over the entire ROW; and in the wire zone, where both trees and tall shrubs were sprayed, nontarget vegetation would be more severely impacted. It was important, therefore, to determine if any of the 5 treatments caused a significant change in deer habitat value in the first year.

Major changes in habitat value did not occur, apparently because the selective treatment of the two, 18 m-wide border zones, removed only trees and left shrubs and low-growing trees (Table 2). There were, however, a number of important changes in specific habitat characteristics in 1983 and 1984. An example was a specific increase in abundance of low vegetative cover after handcutting, caused by development of tree sprouts. Handcutting also reduced tall shrub cover, except on the border zones where bear oak and witch-hazel were left standing.

Although selective herbicide treatments, summer basal spray and frill and squirt, were not followed by significant changes in specific habitat characteristics in 1983 and 1984, measurable de-

creases did occur in 3 direct factors, which in total caused a minor decrease in total habitat values (Table 2). On the other hand, the more drastic stem-foliage spray was followed by significant decreases in both plant food abundance and diversity. This was particularly evident on areas where tree density was high so that the spray covered most of the ROW area (Figure 2). The other drastic herbicide treatment, picloram pellet application, produced significant decreases in abundance of food plants. However, both drastic treatments resulted in an increase in cover type interspersed which is important to deer, as well as to other wildlife.

In comparison with the ROW, the habitat value of 5.9 for the adjoining forest in 1984 was significantly lower ($P = 0.05$) than any of the ROW treatment area values of 7.3 to 7.5.

Effect of treatments on deer presence. The primary reason for studying deer presence on the ROW by fecal pellet group counts in 1982 (pretreatment) and 1983 and 1984 (post-treatment) was to determine if deer used the ROW treatment areas before treatment and if use continued after treatment (Figure 3). Pretreatment deer use was highly variable, which is apparently typical for a ROW (Bramble and Byrnes, 1972). Although deer concentrated their use at specific locations along a ROW in response to such factors as topography and natural variations in vegetative cover, it was still possible to discern that deer used all treatment areas in 1983 and that use increased in 1984.

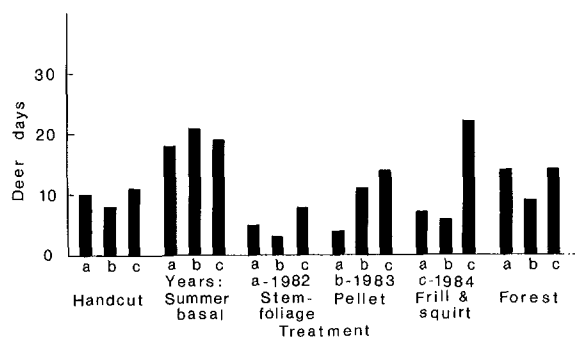


Figure 3. Deer days per hectare on treatment areas and in the adjoining forest for 1982 (pretreatment) and in 1983 and 1984 (post-treatment).

$$\text{Deer days} = \frac{\text{no. fecal groups per ha}}{13 \text{ fecal group depositions per day}}$$

Deer were observed during the study using the ROW for feeding, bedding down, and escape cover. Fawns were often encountered in early summer feeding on the ROW or concealed in the dense low cover.

Deer presence in the adjoining forest averaged 14 deer days per ha in 1982 (pretreatment) following a large increase in understory vegetation after an insect kill as opposed to 9 deer days per ha on the ROW (Figure 3). However, in the post treatment years of 1983 and 1984, deer days per ha in the forest (9 and 14, respectively) were almost the same as on the ROW (9 and 15, respectively).

Deer browsing on the ROW and in the forest.

Woody vegetation was browsed lightly to heavily both on ROW treatment areas and in the forest (Table 3). The average percent browsed of 8.7 on the ROW and 9.8 in the forest were not significantly different at the 5% level.

Herbaceous vegetation was browsed lightly on most ROW treatment areas with a few browsed moderately; and lightly to moderately in the forest. The average percent browsed was 2.9 on the ROW and 2.9 in the forest.

Woody species commonly browsed on the ROW were blackberry, witch-hazel, sassafras (*Sassafras albidum*), black cherry, and red maple. Herbaceous species were whorled loosestrife (*Lysimachia quadrifolia*), goldenrod (*Solidago* spp.), and bracken (*Pteridium aquilinum*).

The utilization factor for woody plants was considerably higher in the forest (429) than on the ROW (223) (Table 3). However, the factor for the handcut areas was 400, which was similar to the forest; the factors for other treatments were much lower than the forest.

The reverse was true for the utilization factor for herbaceous plants (Table 3). The factor was 136 for the ROW average as compared to 84 for the forest, where herbaceous vegetation was sparse. The factor for herbaceous vegetation was particularly high for the pellet treatment owing to a combination of heavy browsing and high cover value.

When the wire zone was compared with border zones, the average was significantly ($P = 0.05$) higher in the wire zone for woody vegetation (Table 3). This difference was shown in particular by

woody vegetation on the pellet-treated wire zone where the fecal group count was also high. However, when the utilization factor was computed (% browsed x % cover), the factor for woody vegetation on the pellet treated areas was very low, owing to a sparse woody cover. On the other hand, the factor for herbaceous vegetation on the pelleted wire zone was relatively high, owing to development of a herb-grass plant cover.

Discussion

Results from this study served to document the important fact that the special ROW maintenance treatments caused only minor changes in total deer habitat values. These values remained in a high value class before and after treatments.

A major reason for the lack of major changes in habitat values was a special technique that was designed to treat the border zones selectively while clearing the wire zone of all tall woody vegetation. This not only reduced the hazard of trees remaining to endanger electric transmission, but also retained a tall shrub cover on the border zones.

Also of special note was the increased cover type interspersed produced by creation of a low shrub-herb-fern plant community in the wire zone as contrasted with a tall shrub-herb-fern community on the border zones. This is quite different from the monotypic ROW usually produced by one treatment applied from edge to edge.

Literature Cited

- Aldous, S.E. 1944. *A deer browse survey method*. J. Mamm. 25: 130-136.
- Bramble, W.C., and W.R. Byrnes. 1972. A long-term ecological study of game food and cover on a sprayed utility right-of-way. *Purdue Agric. Exp. Sta., Research Bull.* 885. 20 p.
- Bramble, W.C., and W.R. Byrnes. 1979. *Evaluation of the wildlife habitat values of rights-of-way*. J. Wildl. Manage. 43(3): 642-649.
- Bramble, W.C., and W.R. Byrnes. 1982. Development of wildlife food and cover on an electric transmission right-of-way maintained by herbicides: a 30-year report. *Purdue Agric. Exp. Sta., Research Bull.* 974. 24 p.
- Carvell, K.L., and P.A. Johnston. 1978. Environmental effects of right-of-way management on forested ecosystems. Final Report Elec. Power Res. Institute, Palo Alto, CA, Project 103-3. 269 p.
- Cavanagh, J.B., D.P. Olson, and S.N. Macriganis. 1976. Wildlife use and management of powerline rights-of-way in New Hampshire. *Proc. First Symp. on Environ. Concerns in Rights-of-way Management*. Miss. State Univ., State College, MS. p. 275-285.

- Eberhart, L., and R.C. Van Etten. 1956. *Evaluation of the pellet group count as a deer census method.* J. Wildl. Manage. 20: 70-74.
- Liscinsky, S.A., C.T. Cushwa, M.J. Puglisi, and M.A. Ondik. 1973. *What do deer eat?* Penna. Game News. May. p. 13-18.

Department of Forestry and Natural Resources
Purdue University
West Lafayette, Indiana 47907

ABSTRACTS

NICHOLS, L.P. 1984. **Thirteen flowering crabapples.** Am. Nurseryman 159(9): 26-28, 30-31.

Crabapples provide a glory of beauty with their spring blooms. Yet the flowering lasts only a short time. When selecting crabapples, one must look also at their form, the color and texture of their foliage, and their fall show of fruit. I have chosen the following baker's dozen of trees with this in mind. In 1982, I submitted a list of my 11 favorite flowering crabapples ("Eleven Excellent Crab Apples," American Nurseryman, October 1, page 90). They are still fine trees. The following list might be considered a supplement. They are 'Bob White,' 'Donald Wyman,' 'Liset,' 'Mary Potter,' 'Ormiston Roy,' 'Profusion,' 'Red Baron,' Redbud Crabapple, *Malus sargentii*, 'Tina,' 'Sentinel,' 'Sugar Tyme,' and 'White Cascade.'

TINGA, J.H. and R. BRAY. 1984. **Place trees properly for a cooler house.** Am. Nurseryman 159(6): 155-157.

In the sunbelt, air conditioning bills are going up every year. Planting vegetation can decrease this buildup. This article deals with findings from a five-year experiment on the effect of planting trees and shrubs close to a 1½-story Cape Cod house. In our landscape, we are chiefly concerned with blocking the sun's rays from coming through the windows and with shading the walls and roof. These heat factors should be considered in placing trees and shrubs in any landscape. The southwest corner of the house is the most critical area to cool. To shield this critical area, tall deciduous shade trees could be placed near the drip line of the house on the south and west sides.